DOCUMENT RESUME

ED 059 481 AC 012 374

AUTHOR Allan, J. N.
TITLE Report on a Study of Developments in Instructional Technology and Their Application to Education for Management Accountants.
INSTITUTION Society of Industrial Accountants of Canada, Hamilton (Ontario).
PUB DATE Nov 71
NOTE 83p.

EDRS PRICE MF-$0.65 HC-$3.29
DESCRIPTORS *Administrative Personnel; Cost Effectiveness; Development; *Educational Change; Educational Needs; Educational Programs; Feedback; *Instructional Technology; Learning Activities; Learning Processes; Media Technology; Objectives; *Research; Resource Allocations; Response Mode; Role Perception

ABSTRACT

A study of Instructional Technology (IT) is presented. Its purposes included: (1) To learn something about the state of the art and anticipate future developments; (2) To relate what has been learned to education for the profession of management accounting at the undergraduate and graduate levels; and (3) To provide a framework of reference which may be used for determining what role the Society of Industrial Accountants should play in the development of instructional systems for educational programs, making judgements in the allocation of resources to the development of instructional programs, and deciding on the approach which should be taken in developing instructional systems most appropriate to Society of Industrial Accountants (SIA) programs. Instructional Technology is defined as the media born of the communications revolution and as a systematic way of designing, carrying out and evaluating the total process of learning and teaching in terms of specific objectives. Its potential benefits include: (1) It provides greater flexibility in matching learner needs and instructional resources; (2) It permits continuing monitoring of an instructional program and achieving the optimum in cost-effectiveness; (3) It broadens the scope for more effective experimentation and innovation; and (4) It provides for the introduction of response and feedback mechanisms. (CK)

ED 059481

U S DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
OFFICE OF EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL OFFICE OF EDUCATION POSITION OR POLICY

REPORT ON A STUDY OF DEVELOPMENTS IN INSTRUCTIONAL TECHNOLOGY AND THEIR APPLICATION TO EDUCATION FOR MANAGEMENT ACCOUNTANTS

by J. N. Allan,
Executive Vice-President,
The Society of Industrial Accountants of Canada

AC 013 374

Hamilton, Ontario,
Canada.
November, 1971

REPORT ON A STUDY OF DEVELOPMENTS IN INSTRUCTIONAL TECHNOLOGY AND THEIR APPLICATION TO EDUCATION FOR MANAGEMENT ACCOUNTANTS

CONTENTS

		Page
	ACKNOWLEDGEMENTS	i to iv
1.	INTRODUCTION	1
	- Purpose	1
2.	INSTRUCTIONAL TECHNOLOGY	6
	1 - What is Instructional Technology	6
	2 - Potential benefits of I. T.	8
	3 - Hazards and risks in I. T.	12
	4 - Roadblocks to acceptance of I. T.	13
	5 - What does the future hold	16
3.	INSTRUCTIONAL DEVELOPMENT	21
	1 - What is Instructional Development	21
	2 - The systems approach	21
	3 - Present learning system	24
	4 - Future learning system	26
	5 - Key elements of I. D.	30
	6 - Definition of environmental factors and organization structure	30
	7 - Objectives	31
	8 - Testing, Measurement and Evaluation	38
	9 - Instructional Strategy and Learning Theory	48
	10 - Media Selection	54
	11 - Subject Matter Presentation	65

ACKNOWLEDGEMENTS

I wish to acknowledge with grateful appreciation the time and assistance given to me during interviews with the following:

Mr. Ron Keast,
McMaster University, Hamilton, Ontario.

Mr. A. S. Knowles, Director, Centre for Instructional Aid,
York University, Toronto, Ontario.

Mr. Peter Somerville, Co-ordinator, Centre for Professional Media;
Professor W. J. McDougall, Professor of Accounting, School of Business Administration;
Professor John Nicholson, School of Business Administration,
University of Western Ontario, London, Ontario.

Mr. L. D. Todgham, Director, Instructional Media Centre,
University of Toronto, Toronto, Ontario.

Mr. Esquith Brown, Director, Instructional Media Centre,
University of Manitoba, Winnipeg, Manitoba.

Mr. R. G. Niveck, Deputy Executive Secretary, Association for Educational Communications and Technology, Washington, D. C.

Mr. Charles Stalford, Office of Planning, Research and Evaluation,
Office of Economic Opportunity, Washington, D. C.

Professor J. D. Montgomery, Chairman, Department of Accounting and Finance;
Dr. T. S. Stroh, Chairman, Department of Instructional Media,
Florida Atlantic University, Boca Raton, Florida.

Dr. Paul Garner, Dean, College of Commerce and Business Administration;
Dr. Robert Freeman, Professor of Accounting;
Dr. J. O. Mason, Professor, Quantitiative Methods and Information Systems;
Dr. W. H. Lucas, Professor of Accounting;
Dr. R. B. Sweeney, Chairman, Department of Accounting,
University of Alabama, University, Alabama.

Mr. Peter Duty, Sales Representative,
Learning Foundation Corporation, Athens, Georgia.

Dr. A. A. Sterns, Director - Planning & Analysis;
Mr. Lynn Tisdal Research Associate - Measurement and Evaluation;
Dr. Joseph Hammock, Professor and Director, Office of Instructional Research and Development;
Dr. John Harris, Assistant Director, Office of Instructional Research and Development;
Dr. David Tyler, Professor & Head, Department of Technology, College of Veterinary Medicine;
Dr. Flewellyn, Dean, College of Business Administration,
Dr. Rudolph White, Director, Instruction, College of Business Administration,
University of Georgia, Athens, Georgia.

Mr. J. Fast,
Sterling Institute of Educational Technology, Washington, D. C.

Mr. J. Thompson, Director-Services,
National Audio-Visual Association, Washington, D. C.

Dr. Albert L. Goldberg,
The Council of the Great City Schools, Washington, D. C.

Mr. E. B. Glassman, Project Officer for Evaluation of Performance Contracting;
Dr. G. E. Austin;
Mr. Frank Bryars, Educational Reference Centre, National Centre for Educational Communication;
Dr. E. Michelsen, Director - Central Office Eduational Laboratories,
Office of Education, United States Department of Health,
Education & Welfare, Washington, D. C.

Dr. William H. Allen, Director of Research, Department of Cinema,
University of Southern California, Los Angeles, Calif.

Mr. J. Ward Harrigan, Director of Development, Innovative Educational Programmes;
Dr. Alexander Schure, President;
Dr. W. W. Smith, Director - Continuing Education,
New York Institute of Technology, Old Westbury, Long Island, N. Y.

Dr. L. C. Blenheim, Professor of Communications;
Mr. William Seibel, Director of Television Services,
Temple University, Philadelphia, Pa.

Mr. H. E. Smith, Vice-President,
Columbia Broadcasting System, New York City.

Mr. Milledge J. Mosby, Vice-President - Sales,
Mind Incorporated, New York City.

Dr. M. S. S. Morton;
Dr. George Dixon;
Dr. Gerry Wilcox,
Massachussetts Institute of Technology, Cambridge, Mass.

Mr. W. Crawford, President,
Learning Systems Incorporated, Homewood, Ill.

Dr. Burdette Hansen, Director;
Dr. C. R. Stevenson, Educational Psychologist,
Measurement Research Centre, Iowa City, Iowa.

Dr. John E. Coulson, Assistant Manager, Education & Library Systems Dept.,
Systems Development Corporation, Los Angeles, Calif.

Dr. J. W. Popham, Director;
Miss Betsy Buck,
The Instructional Objectives Exchange, Los Angeles, Calif.

Dr. John W. Buckley, Assistant Professor, Director, Accounting & Information Systems Research Programme and Chairman, Research Committee;
Dr. Richard O. Mason, Assistant Professor;
Dr. Eric Flamholtz, Assistant Professor;
Dr. George A. Steiner, Professor & Director of Division Research;
Dr. Raymond H. Goldstone, Co-ordinator for Academic Change & Curriculum Development for the University of California,
University of California, Los Angeles, Calif.

Mr. Charles T. Horngren, Professor of Accounting;
Mr. Keith G. Lumsden, Professor of Economics,
Graduate School of Business, Stanford University, Calif.

Mr. Maynard J. Kuljian, Manager, Instructional Systems Dept.;
Mr. Robert L. Ellsworth, Application Engineer,
Ampex Corporation, Redwood City, Calif.

Dr. L. B. Mayhew, Division of Education,
Stanford University, Stanford, Calif.

Dr. David Cram, President,
Dr. Bitterlich, Vice President,
General Programmed Learning Incorporated, Palo Alto, Calif.

Mr. William Carroll, Director,
Continuing Education of the Bar, Berkley, Calif.

Dr. M. David Merrill, Director, Instructional Research and Development,
Brigham Young University, Provo, Utah.

Dr. Weldon C. Taylor, Dean of the School;
Dr. Dale Taylor, Professor of Accounting,
Graduate School of Business Administration,
Brigham Young University, Provo, Utah.

Mr. Charles Lockwood, Acting Director of Extension;
Mr. Lynn Zelmer, Assistant Professor - Communications,
University of Alberta, Edmonton, Alberta.

Mr. R. J. Harvey, Director - Administration,
Bell Training Centre, Belleville, Ont.

J. N. Allan

REPORT

on a study of

DEVELOPMENTS IN INSTRUCTIONAL TECHNOLOGY

and

THEIR APPLICATION TO EDUCATION FOR MANAGEMENT ACCOUNTANTS

1

INTRODUCTION

1. PURPOSE

The purpose of this study of Instructional Technology (I. T.) was threefold:

1. 1 To learn something of the state of the art, and to catch a glimpse of what developments may be anticipated in the future.

1. 2 To relate what has been learned to education for the profession of management accounting at the undergraduate and graduate levels.

1. 3 To provide a framework of reference which may be used for:

- determining what role the Society of Industrial Accountants should play in the development of instructional systems for educational programmes related to the attainment of professional qualification and to continuing professional development.
- making judgements in the allocation of resources to the development of instructional programmes if it is decided this is the course of action which should be taken.

- deciding on the approach which should be taken in developing instructional systems most appropriate to S. I. A. programmes, having regard to the objectives to be achieved, the environmental circumstances in which the programmes are offered, and the resources available.

This report is the result of a comprehensive, but by no means exhaustive, review of available literature on the subject, and interviews with many people who have made a significant contribution to the advancement of knowledge in the field of instructional technology.

At the outset it should be stated that most of the research and experimentation in I. T. has been directed to the primary and secondary levels of the public educational system. A relatively small proportion of the total effort has been related to the college and university levels, and still less to the schools of commerce and business administration. However, much of what has been learned can be transferred to educational programmes for the accounting profession. This statement is made recognizing the hazards of generalizations in discussing the application of I. T. It is an oft repeated warning, with justification, that no instructional system has universal application. Each system has to be designed according to the objectives to be met, the needs of the learner, and the circumstances under which

the programme operates. Notwithstanding, many ideas which have proven to be effective in one setting can, with imaginative modification, be transferred to another setting, with reasonable expectation of success. Conversely, it may be assumed that ideas which are not effective in one situation, may be transferred to another with favourable expectations because of more compatible circumstances. Many of the roadblocks to innovation in the public educational system, and in colleges and universities are not present in a professional association, as will be brought out in this report. The converse is also true.

It is a frequently stated truism, that science and technology advance at a rate considerably greater than the rate of growth in our capacity to use them. This is particularly true in the realm of instructional technology. In making even a cursory review of available literature, one is struck by the very substantial amount of research and experimentation that has been undertaken to improve the efficiency and effectiveness of instructional systems. It is therefore surprising to find that, proportionately speaking, little has been achieved in applying that which has been learned, particularly at the post secondary and graduate levels.

> "Five decades of instructional media research have resulted in a mass of results still awaiting for synthesis and interpretation and a knowledge about the media and their use that will be useful in accomplishing this task. Taken with the theories of learning and teaching that have evolved and the research in such areas as human information processing perception and human development it may be possible to evolve a true theory of instructional media. ---

> ---There is reason to expect that the present growing attention being given to the study of the unique attributes of instructional media and their relationships to the characteristics of the learner and the nature of the instructional task will be increased in the future." (1)

Because of the wide gap between promise and realization in the application of I. T., contemporary experience should be studied in the light of future possibilities. Moreover, instructional media is in a constant state of improvement and refinement.

> "Examining the impact of technology on American Education in 1969 is like examining the impact of the automobile on American life when the model T Ford first came on the market. The further ahead one looks, the more benefits technology seems to hold out for education." (2)

We must distinguish between long range promise of instruction technology and the technology that is ready for immediate delivery. Of his book, Run, Computer, Run, Mr. Anthony Oettinger says,

> "I wrote Run, Computer, Run, not as a Luddite fearful of the Machine, nor as a shrinking humanist living in the past, but as a scientist and engineer convinced that educational technology holds great promise." (3)

Anything that touches upon education touches the very basis of human progress in all realms of society. On this assumption alone, one would have to conclude that high priority should be given to investigation and implementation of measures that offer opportunity for improvement in the quality and variety of methods that could facilitate the teaching and learning process.

But change, however promising and desirable it may be, extracts a price and imposes risks. The task, then is to recognize the potential benefits which I. T. has to offer, its possible application to specific situations, and to be aware of its hazards and deficiencies. It is hoped that this report will be helpful towards achieving such understanding when considering the application of I. T. to education for the management accountant.

References:

(1) Wm. H. Allen, Instructional Media Research: Past, Present and Future, AV Communication Review Vol. 19, No. 1, P. 14.

(2) To Improve Learning, Vol. I, Edited by S. G. Tickton, R. R. Bowker Company, New York and London, 1971, P. 21.

(3) Anthony Oettinger, Run, Computer Run, Harvard University Press, 1969.

2

INSTRUCTIONAL TECHNOLOGY

1. WHAT IS INSTRUCTIONAL TECHNOLOGY

> "Instructional technology can be defined in two ways. In its more familiar sense, it means the media born of the communications revolution which can be used for instructional purposes alongside the teacher, textbooks, and blackboard. ---
>
> The second and less familiar definition of instructional technology goes far beyond any particular medium or device. In this sense, instructional technology is more than the sum of its parts. It is a systematic way of designing, carrying out and evaluating the total process of learning and teaching in terms of specific objectives, based on research in human learning and communications, and employing a combination of human and non-human resources to bring about more effective instruction. The widespread acceptance and application of this broad definition belongs to the future." (1)

I. T embraces a large and ever increasing assortment of equipment, devices and techniques such as educational television, computer assisted instruction, programmed materials, teaching machines, simulated games, instructional films and videotapes, slides and textbooks. It is commonly assumed that instructional technology is restricted to the use of mechanical communications media. The definitions quoted above not only refer to the combination of human and non-human resources in the teaching and learning process, but it implies considerably more.

> "Technology is not just machines and men. It is a complex, integrated organization of men and machines, of ideas, of procedures, and of management. The introduction of this complex organization generates many systematic problems than can be and have been ignored or generally neglected in theory, research and practice in education." (2)

Because of the propensity to emphasize one component to the detriment of the others, and because of the assortment and complexity of instructional devices and methods, an integrated and systematic approach is needed for planning, operating, and evaluating an instructional programme. Efforts in this direction are reflected in activities such as team teaching, language laboratories, and computer assisted instruction.

It is a common argument that planning and co-ordination of academic activities can result in a stifling of creativity and retard the instructor from pursuing his interests in research and instruction. This fear mirrors the difficulties encountered in using the hardware of instructional technology. Fundamentally, the problem in instructional technology lies in the failure of the proponents of its elements to accept that instruction, regardless of its form, is geared to assist the student to learn. The critical element is the information to be transmitted while the intent of the technology is to convey knowledge from a source of learning or an information storage device such as a textbook to the learner. In effect, the role of instructional technology is to facilitate the learning process. Failure to gear the available tools to this role can result in a dissonant interaction between the elements involved in the instructional process.

I. T. also implies an integrated systems approach to planning, operating and evaluating an instructional programme. The descriptive word is synergism: co-operative action of individually distinct agencies such that the total effect is greater than the sum of the separate elements taken individually.

While the second definiton of I. T. quoted on page 6 may belong to the future in its application, it will be in the context of that definition that the term is used in this report.

2. POTENTIAL BENEFITS OF I. T.

Significant change in anything so fundamental as the teaching and learning process will have profound and widespread implications. Only a major study could identify the probable long term impact which I. T. can have on society as a whole.

> "The major impetus for progress will come from education and the technological innovations it utilizes." (3)

The purpose here is to mention only a few of the implications that have relevance for professional education.

2.1 I. T. provides greater flexibility in matching learner needs and instructional resources.

Proper use of instructional technology can effectively match instructional resources with student needs. The student may learn more easily by following a particular method of study rather than another. The individual, depending upon the subject matter to be assimilated, may need more practice or repetition to absorb and retain the message as opposed to the needs of another student. In effect, the learner selects the mode (means) by which he learns and adjusts the pace of learning to his ability. This is particularly relevant in adult education where the student population may be marked by a wide range of intellectual capacities, work experience, and academic

achievement. The system must allow for such differences between individuals. (4) .

2. 2 I. T. permits continuing monitoring of an instructional programme and achieving the optimum in cost-effectiveness .

Because I. T. implies a systematic way of designing, carrying out, and evaluating the total process of learning and teaching in terms of specific objectives, it follows that it makes possible a continuous process of refinement and improvement. It also permits comparison of the cost-effectiveness of one system as against another, even though, at the present time, this is more theoretical than current practice would indicate.

> "By and large, the research in media investigates either how to make a particular medium more effective, or how one medium compares with another. Research problems of the system as a whole have been left virtually untouched." (5)

2. 3 It broadens the scope for more effective experimentation and innovation.

On the assumption that valid evaluative techniques have been incorporated into the system, there is a basis for measuring the comparative effectiveness of variations in the system.

> "It is interesting to note that curriculum reforms are generally ineffective, make little headway, and lack traction until they are "materialized" into instructional materials, learning environments, and systems of instruction." (6)

2. 4 <u>It provides for the introduction of response and feedback mechanisms</u>.

> "Many people see instructional technology primarily as a way of recording, storing, transmitting, distributing, and displaying material. But equally important is its capacity for response and feedback and for reinforcement of learning. Some of the most fruitful uses of technology for instruction aim at carrying out these functions, in ways which may be beyond the capability of the teacher. Programmed learning, for example, provides immediate, constant, and infinitely patient feedback." (7)

Immediacy of feedback affects learning. Immediate knowledge of results is more effective than delayed knowledge even when the delay is only until the next class meeting. This is of particular significance to students who get their instruction by the correspondence method or by attending periodic evening lecture classes.

2. 5 <u>I. T. can of itself, be a means of developing self discipline and self direction</u>.

In the professions, as in other forms of educational development, learning and teaching have been oriented to the attainment of a level of knowledge and skills as measured by terminal tests for professional certification. The learner has simply followed the teacher along a prescribed path of learning with periodic tests or examinations serving as check points until he reaches the wide open spaces of professional practice. From there on he is completely on his own so far as continuing the process of learning is concerned. He has not been conditioned to the state of continuing professional development. Is it any wonder then that the knowledge and skills

of so many professionals is much the same as that at the time of graduation, refined only by the trial and error of practice.

I. T. can be designed to offer a process of learning that imposes upon the learner a choice of learning strategies that will require him to make decisions in the selection of instructional resources. Is it possible that such a learning experience will cultivate a self discipline and self direction that is regenerative and continuing beyond graduation? It is a thought worth exploring.

> "Technology connotes a degree of predictability, precise definition of functions and operations, and reproducible performances. Technology systematizes education into predictable relationships. The aim of education, broadly conceived, is to maximize human fulfilment. The process of education involves determination of desired student behaviour, the analyzing, relating, ordering, or arranging of learner activities that will develop the desired level of performance, and the creation of responsive environment (human and non-human mediation) that motivate and induce the learner to interact with the structured environment, and provide feedback to the learner and teachers for the guidance of learner activity. Ideally, in this process we hope the learner develops his own discipline for continued self direction. Educational technology applies a scientific approach to this undertaking." (8)

2. 6 <u>I. T. can make access to education more equal.</u>

> "Technology does not have to move people: it transmits the impact of people." (9)

Through the use of different types of media, it is possible to extend the benefits of the best instructional programmes to a greater number who do not now have access to teaching centres. Moreover, technology can provide greater access to resource information centres.

3. HAZARDS AND RISKS IN I. T.

3. 1 Misuse of media

It is obviously easier to run a film or a video tape of a programme that happens to be available than to prepare and deliver a lecture. It is much more convenient to tape a lecture and then use it for other classes than to repeat the same lecture live. It is true that some of the benefits from I. T. are to be realized in the use of filmed, taped or other types of mediated presentations where such presentations fit the objectives of the course and are appropriate to the level of learning in the curriculum. However, if media is simply used as a convenience, the results can be damaging to the students.

3. 2 Centralized control can increase conformity

The systems approach which characterizes I. T. demands a higher degree of centralized control of planning, testing and evaluating, if its full range of benefits are to be realized. This means control over content and presentation of subject matter. It also means a greater standardization of instructional programmes. In the course of time it can be expected that choices of instructional programmes for specific subjects would be available from a central service just as we now have a choice of textbooks. The risks and benefits of centralization have to be weighed against the risks in the present system where the student in the traditional lecture class has no choice except as between the teacher and the text for his instruction.

> "A system based on remote information storage might make control over subject matter far easier than it is in our present society. One need only picture the use a Hitler or a Stalin could have made of a national educational information pool to understand the seriousness of this problem. Using regional rather than national information centres, or foreign as well as domestic sources might reduce this uniformity. Indeed, some of the homogeneity now evident in the lower schools might be alleviated by a system which can give access to a much wider range of literature than a bigoted local school board would allow today." (10)

3.3 Unjustified expectations

The use of technology automatically stimulates high expectations, and the greater the sophistication the greater the expectations. Moreover, there is a sense of immediacy in the benefits anticipated. If realization does not measure up to expectations, there is a tendency to reject the whole system. Disenchantment discourages a rational analysis of deficiencies, which might be corrected with the result that, often, major advantages are lost because of relatively minor problems.

4. ROADBLOCKS TO ACCEPTANCE OF I. T.

In practically all the literature that deals with the state of the art today, there is the common complaint that, in proportion to the effort put forth in research and experimentation to exploit the benefits of technology, little has been accomplished in translating the results into ongoing operational systems. There is little evidence that the teaching and learning process has been significantly changed.

> "Instructional technology is today largely supplementary to the two primary media of instruction: the textbook and the teacher. Eliminate either of these and the educational system would be transformed. Eliminate all of the technology, and education would go on with hardly a missed lesson." (11)

There are many factors that influence attitudes toward innovation. The number and combination of factors are multiplied by the number of people and/or agencies involved in the decision making process. In education they include the teachers, the administrators, and the administrative bureaucracy, the funding agencies, and, in the case of the public school system, the parents. Some of the facts are very real and quite valid. Others are psychological.

It is the intention here to direct attention only to those roadblocks to instructional innovation that have relevance to a professional organization.

4.1 Lack of an integrated systematic approach to planning and implementation of instructional systems

> " Though only a limited number of institutions have attempted to design instruction using a systematic comprehensive approach, there is reason to believe that this approach holds the key to the contribution technology can make to the advancement of education. It became clear, in fact, as we pursued our study, that a major obstacle to instructional technology's fulfilment has been its application by bits and pieces. " (12)

The disenchantment with closed and open circuit television is a case in point. While television has an unlimited capability to magnify the exposure of an effective teacher and a dramatic visual presentation, it has an equal capability to magnify the exposure of an ineffective teacher of a dull presentation. Moreover, a teacher who is effective in a classroom situation with a live audience may fail completely to project well before an impersonal camera.

> ". . most innovators have chosen or been forced to confine themselves to their own special medium or technique. Rather than moving into the centre of the planning process in education, most technologically oriented educators are on its periphery. " (13)

4. 2 The fear of dehumanization of teaching

Because of the emphasis on gadgetry, there has been real concern, with some justification, that teaching will become depersonalized. This is particularly true in higher education.

> "Resistance to instructional technology among students and teachers appears to be in direct ratio to the grade level. This is borne out by observation as well as by such studies as have been made. Elementary school children and teachers accept television or films far more readily than college students and teachers. ("I am a student. Do not fold, spindle, or mutilate," read the protesting campus signs.) Primarily fears center around prospects of depersonalization, standardization, conformity and the gradual elimination of whatever diversity now exists." (14)

Overzealousness in the use, and overselling, of many promising devices have resulted in their misuse,and have actually interfered with the educational process.

4. 3 Lack of quality instructional programmes

Students and teachers have resisted technology in education because of their experience with poor quality programmes. This is due in large part to the high cost of good quality. Instructional requirements for the professions in particular are so diversified, and the number of students so small in most courses that it is impossible for commercial firms to produce such materials.

On the other hand, there is also an underlying attitude, steeped in tradition, that teaching is a serious business, serious in the sense that it is devoid of humour, (unless the teacher himself is blessed with this rare quality) glamour, or anything that is dramatic, and that it can only be achieved in a face to face relationship between

teacher and pupil. As a consequence, little attempt has been made to take full advantage of the opportunities instructional media offer to dramatize the teaching process, and make it exciting, stimulating and attractive to the learner.

> "That the Beverley Hillbillies is more popular than N. E. T. should not cast blame on the populace, but on the programming of N. E. T.
>
> Given the necessary and adequate funding with creative and imaginative producers and writers, ETV can be as interesting and communicative as commercial TV.
>
> ---Why is there the attitude that we must not "entertain" our student audiences? Why are textbooks dull? There is simply no support, either financial, or in the faculty reward system for making an instructional programme exciting and stimulating. There is no system to reward the innovator and there is no particular reason to evaluate the results. Why evaluate if nothing different is going to occur? The academic institutions may be competent but they may also be impotent." (15)

5. <u>WHAT DOES THE FUTURE HOLD</u>

> "The further one looks ahead, the more benefits technology seems to hold for education." (16)

The lack of enthusiastic acceptance of instructional technology can frequently be laid to the fact that the promise of the future is often obscured by the realities of the present. As stated in the Introduction to this report, "we must distinguish between long range promise of I. T. and the technology that is ready for immediate delivery." What then, can we anticipate in the future that should be considered in making judgments today?

In his paper, "Innovations in Industry Likely to Affect Instructional Technology During the Next Ten Years", (17) Mr. Hugh Beckwith gives a comprehensive review of the advancements we can expect, and he identifies

the significant requirements needed to transfer promise into reality. The following are extractions from Mr. Beckwith's paper that are pertinent to this study:

5. 1 Broad Areas of Technological Advance

One of the major factors in I. T. will be the expanded use of the computer. At the same time, there are some real doubts that the cost effectiveness will ever justify the use of the computer for instructional purposes, except in a few limited areas, such as in business games, and in the teaching of quantitative subjects such as statistical analysis, operations research, and the use of mathematical models. However, there is general agreement that the computer will be used extensively in managing instruction. The present limitation to the use of the computer in this regard is cost.

> "Currently, the cost of using computers in many of the ways envisioned in the future is prohibitive. This is changing rapidly. The accelerating progress of the basic electronics technology used in computers is already making significant cost reductions possible." (18)

5. 2 Examples of Specific New Products to be Expected

Continued improvement in the design of equipment now available with a better understanding of their capabilities, will result in acceptance of facilities that are now rejected because they are considered ineffective. In addition there will be new products that will extend the usefulness of existing applications as well as introduce new applications. Some of them are:

"Large screen television display systems at acceptable costs.

Combination television receivers and motion picture projectors. Association or combination of video tape and film techologies to produce more flexible formats at lower costs.

Packaging of software in relation to hardware to produce more convenient, reliable use.

Long lasting, inexpensive (perhaps $20. 00 or less) television receivers that can be optionally operated on battery power.

Inexpensive, easy to operate video tape players and recorders.

Light-weight, small, perhaps textbook size, microfilm and microfiche readers.

Use of microfiche technology to provide rapid random access, large capacity slide projection.

Television screen which will be able to receive an image and retain it as long as desired without the need to regenerate the signal. These screens will also make possible the display of overlays or other images.

Much lower cost computer terminals. Substantial progress should be made in this field within five years.

The foregoing list relates primarily to items that are commonly called hardware. In addition to these developments and others which will undoubtedly come, it can be expected that greatly simplified methods for preparing various kinds of software will be developed.

Of all of these developments perhaps the most important of all will be the creation of large quantities of instructional materials that will have precisely stated objectives and will include diagnostic preinstruction tests and criterion achievement tests.

--- Many of these materials will involve student in the learning process, require active response from him, permit him to progress at his own rate, and will allow him considerable control and direction of his learning activities." (19)

5. 3 Basic Requirements to Realize Potential Benefits

The first requirement is recognition of the need for change, and for a long term (3 to 5 years) commitment to plan, test, implement and refine an instructional system. It takes time to plan and test an instructional programme, and to make it operational. Even then deficiencies must be expected which can only be corrected with experience.

There must be acceptance, by all concerned, of the principle that instructional development is an integrated, multidisiciplinary effort, involving those expert in the subject to be taught, in communications theory and practice, behavioural science or educational psychology, media technology, and statistical analysis. The effort of such a team will probably be co-ordinated by a person expert in instructional development, a field now recognized for doctoral studies in several universities.

References:

(1) To Improve Learning, Vol. I, Edited by S. G. Ticton, R. R. Bowker Company, New York and London, 1971, P. 21.

(2) C. F. Hoban, quoted by Robert Heinich, What is Instructional Technology: AV Instruction March, 1968, P. 220

(3) Bell and Kahn, quoted by J. J. Servan-Schreiber, The American Challenge, P. 57, Avon Books.

(4) M. Daniel Smith, Morton Schagrin, L. Eugene Poorman, Multimedia Systems: A Review and Report of a Pilot Project, AV Communication Review, Vol. 15, No. 4, Winter 1967, P. 347.

(5) Robert Heinich, What is Instructional Technology: AV Instruction, March 1968, P. 222.

References: (Cont'd)

(6) Phil C. Lange, Technology, Learning and Instruction: AV Instruction, March 1968, P. 228.

(7) To Improve Learning, Vol. I, Edited by S. G. Tickton, R. R. Bowker Company, New York and London, 1971, P. 32

(8) Phil C. Lange, Technology, Learning and Instruction: AV Instruction, March, 1968, PP. 229 & 230.

(9) To Improve Learning, Vol. I, Edited by S. G. Tickton, R. R. Bowker Company, New York and London, 1971, P. 35.

(10) Anthony Oettinger, Run, Computer Run, Harvard University Press, 1969, P. 12.

(11) Norman D. Kurland, quoted in To Improve Learning, Vol. I, Edited by S. G. Tickton, R. R. Bowker Company, New York and London, 1971, P. 21.

(12) Op Cit, PP. 21 & 22.

(13) Ibid P. 23.

(14) Ibid P. 26.

(15) Richard E. Spencer, The Role of Measurement and Evaluation in Instructional Technology, a paper prepared for the Commission on Instructional Technology.

(16) To Improve Learning, Vol. I, Edited by S. G. Ticton, R. R. Bowker Company, New York and London, 1971, P. 29.

(17) Hugh Beckwith, Innovations in Industry Likely to Affect Instructional Technology During the Next Ten Years, a paper prepared for the Commission on Instructional Technology, and published in the book To Improve Learning, Vol. II, R. R. Bowker Company, New York and London, 1971.

(18) Ibid, P. 846.

(19) Ibid, P. 849.

3

INSTRUCTIONAL DEVELOPMENT

1. WHAT IS INSTRUCTIONAL DEVELOPMENT

There are a variety of definitions of Instructional Development (I. D.), but the one that seems to be most appropriate to the purpose of this study is that offered by Prof. Kent L. Gustafson:

> "Instructional development is essentially pragmatic, eclectic and behaviouristic. It is pragmatic in that it focuses on what works, whether or not an adequate explanation exists. It is eclectic, drawing from a number of disciplines including, but not limited to, psychology, social psychology, sociology management, anthropology, and communications. I. D. is in the enviable position of not being a classical discipline which must defend its boundaries. Rather it is free to draw from whatever sources are useful. It is behaviouristic in that it focuses on students' learning and the observations of students' behaviour. It is not grounded on any specific learning theory, but draws from a variety of behaviouristic learning theories. The criterion is, "Is it useful?" (1)

It raises the question of what specific roles can be most appropriately carried out by which people or what things or what instrumentation. In a way, we are asking: "Who does what? What does what to whom and with what effect in terms of learning behaviour?" (2)

2. THE SYSTEMS APPROACH

In this report, the term "system" has been used frequently in the "systems approach", (the process), and in the development of the "instructional system", (the product). In both cases, the term implies the linking together of elements to achieve the optimum results in the use of available resources in relation to desired

objectives. Within each element there may be one or more sub-systems. The system concept not only employs a variety of elements, but provides for the flow of information in both directions between elements. Further, it implies the use of control points at critical stages of progress to determine if the programme or project is on target or if adjustments are needed.

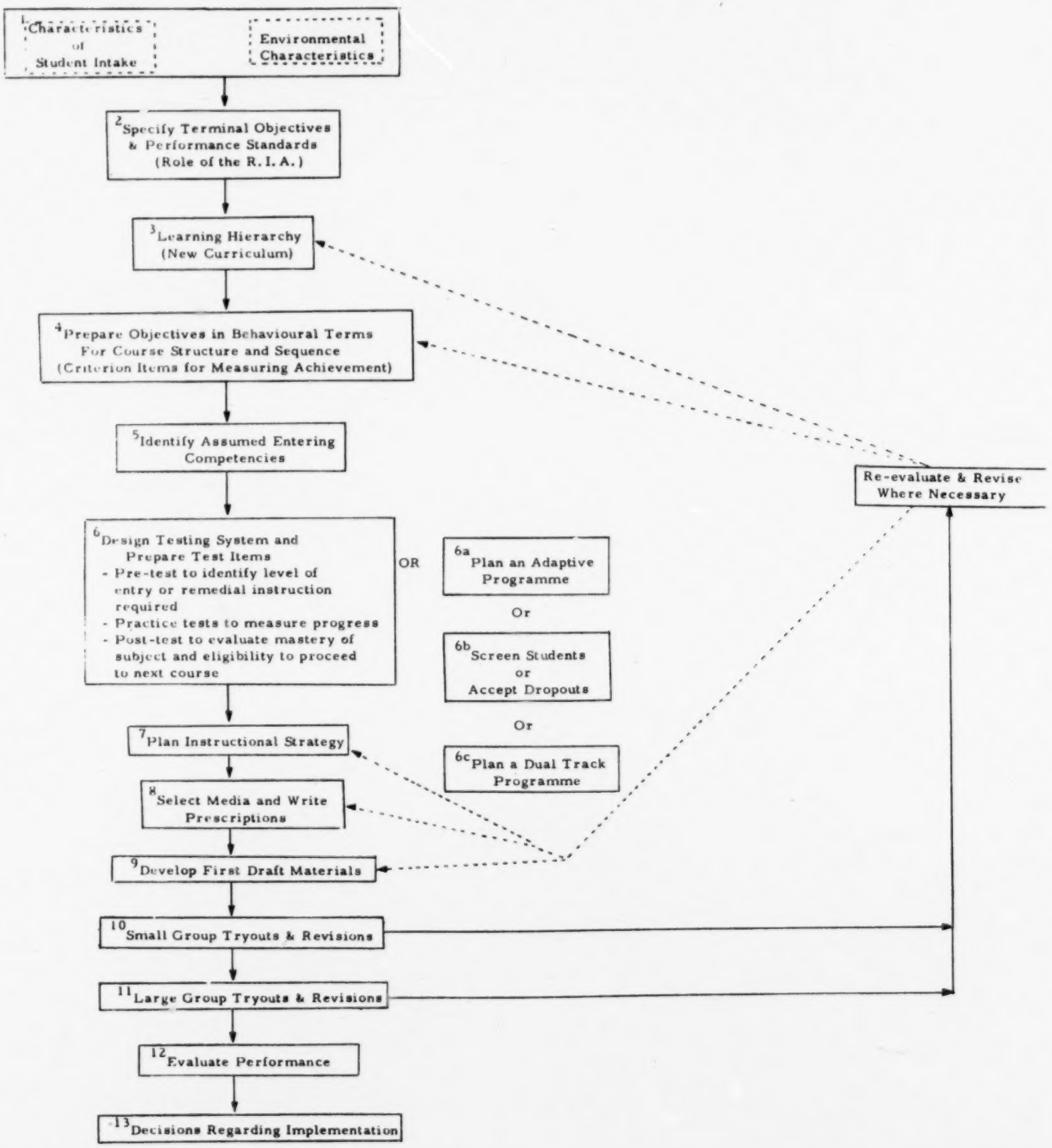
> "The strength of a systems approach lies in the analysis of alternate pathways through which the desired terminal objectives may be attained. The selection of transforms (or pathways) relating the output to the input are subject to alteration as information is accumulated in the analysis and implementation of the system." (3)

The objective of I. D. is the evolvement of an instructional system that combines available human and/or non-human resources to achieve optimum results in relation to the desired objectives, having regard to environmental circumstances, and which provides for continuous performance analysis and evaluation of the learner, teacher, and the programme. The plan must be flexible enough to adjust to change with the evolvement of new insights, and the discovery of new techniques.

The process of I. D. can best be presented in the form of flow charts or models. This, however, implies linear programming, which is not the case. The key elements in I. D. are interdependent. One cannot be designed in isolation from all others, but for simplification, they will be presented here in sequence, and for illustrative purposes, reference is made to the flow chart shown in Exhibit 1. It is essential that the plan be viewed in its totality

EXHIBIT 1

ILLUSTRATION OF A MODEL FOR INSTRUCTIONAL DEVELOPMENT
IN THE R.I.A. PROGRAMME


1 Characteristics of Student Intake
Environmental Characteristics
2 Specify Terminal Objectives & Performance Standards (Role of the R.I.A.)
3 Learning Hierarchy (New Curriculum)
4 Prepare Objectives in Behavioural Terms For Course Structure and Sequence (Criterion Items for Measuring Achievement)
5 Identify Assumed Entering Competencies
6 Design Testing System and Prepare Test Items
- Pre-test to identify level of entry or remedial instruction required
- Practice tests to measure progress
- Post-test to evaluate mastery of subject and eligibility to proceed to next course
OR
6a Plan an Adaptive Programme
Or
6b Screen Students or Accept Dropouts
Or
6c Plan a Dual Track Programme
7 Plan Instructional Strategy
8 Select Media and Write Prescriptions
9 Develop First Draft Materials
10 Small Group Tryouts & Revisions
11 Large Group Tryouts & Revisions
12 Evaluate Performance
13 Decisions Regarding Implementation
Re-evaluate & Revise Where Necessary

August 12, 1971

even while considering each of its elements separately.

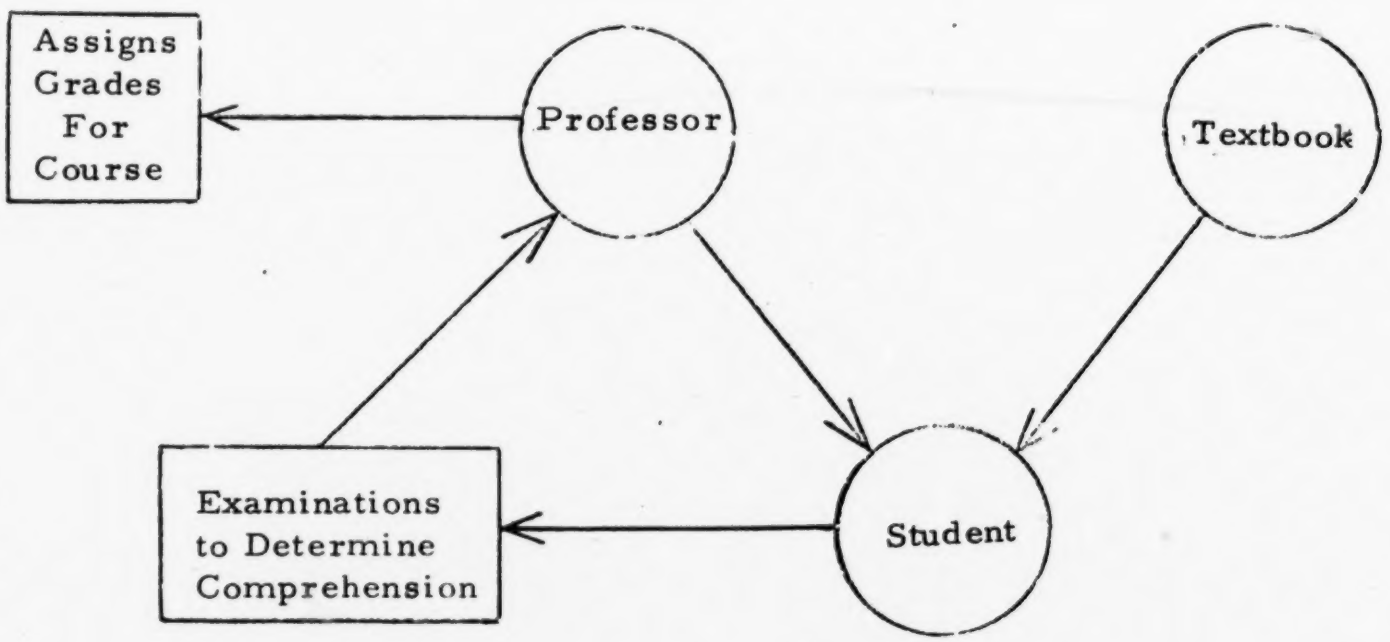
Possibly the best way to point up the need for, and the attributes of, the systems approach to I. D. is to contrast the characteristics of the conventional learning system with those that will apply in the future. Such a comparison has been effectively presented in a monogram issued by the Learning Systems Company (4). Sections 3 and 4 shown below describing the present and future learning systems are drawn from this monogram.

3. PRESENT LEARNING SYSTEM

The present learning system which is typical of that used in many college learning situations can be diagramed as shown in Exhibit 2. (4)

Exhibit 2

Typical Present Learning System



While a variety of methods are used by many professors to stimulate learning, essentially the two inputs are the professors' lectures and the textbook. The student assimilates this information and takes examinations to demonstrate his knowledge. The professor considers the examination scores as a major factor in assigning final grades for the course. Grades range from "A" through "F", and those who are unable to perform at an acceptable level are required to repeat the course and may eventually be required to abandon the learning process entirely.

3.1 Characteristics of the Present System

The characteristics of the present learning system are:

3.1.1 Often there is one-way communication during the learning process. This is true when the professor uses the lecture method and the textbook is not in programmed learning format. Where classroom discussion is used, the communication between certain students and the professor is two-way.

3.1.2 Feedback provided by examination scores often has little or no effect on the future stimuli provided by the inputs (professor and textbook). The student must adjust to the learning system if he is to be successful in the learning situation.

3.1.3 The number of learning aids is limited, and often they are not integrated.

3. 1. 4 The learning situation is not individualized. All students are generally provided with the same stimuli (lectures and reading, with similar content for each student), regardless of the student's existing knowledge, aptitudes, and capacity for learning. The learning efficiency level for most students is apt to be quite low.

3. 1. 5. The variable in the results achieved in the learning system is comprehension level attained rather than time spent. Each student tends to spend the same amount of time (with the possible exception of the reviewing process). The comprehension level attained in that time period varies considerably among students.

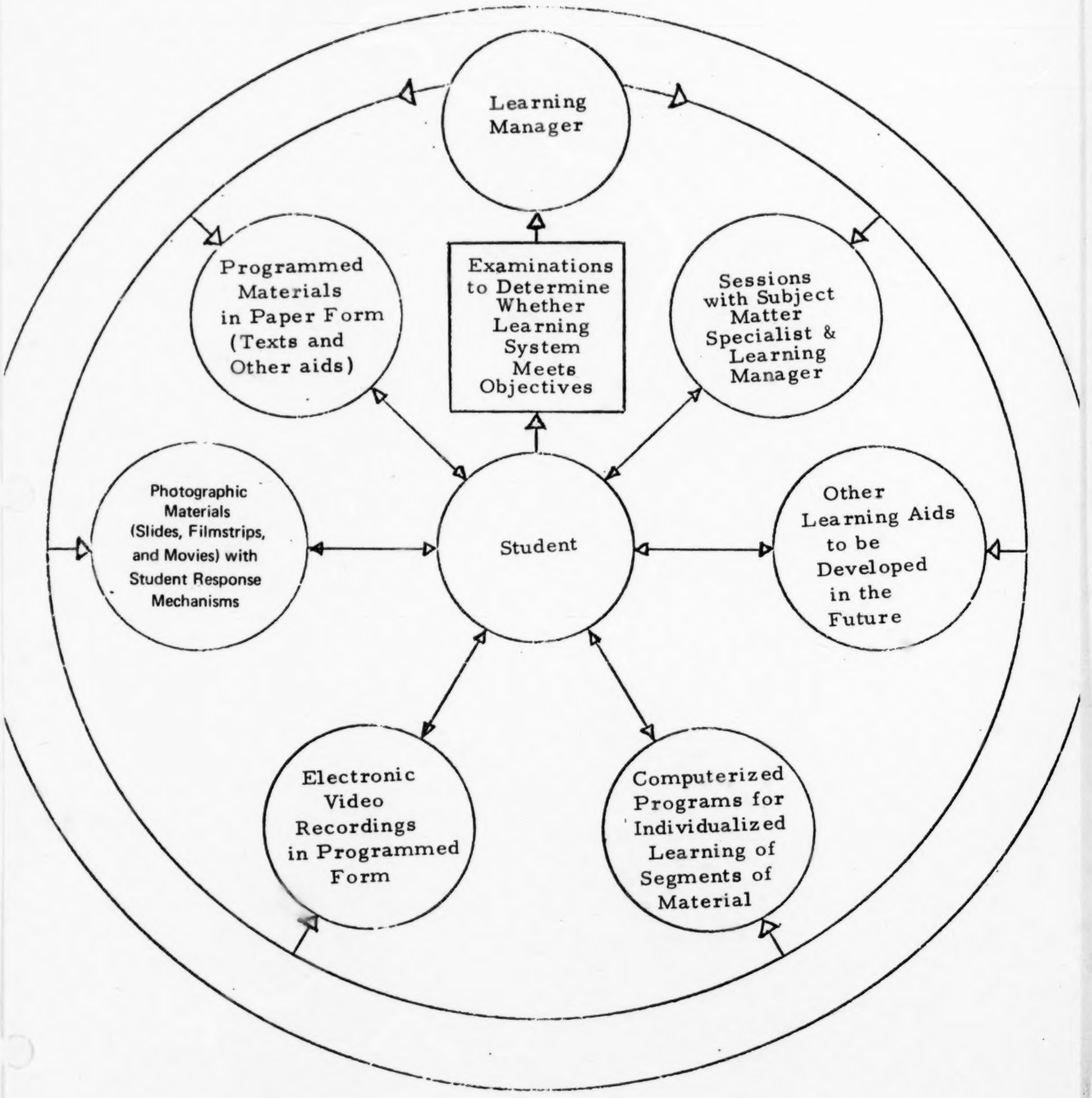
4. FUTURE LEARNING SYSTEM

One can only speculate, of course, as to the ex act nature of the typical future learning system, but present trends in educational technology would seem to indicate that a learning model will evolve, such as shown in Exhibit 3.

The student is at the centre of the learning system depicted. There are various learning aids designed to aid the student in attaining a planned level of comprehension. The communication between the student and each of the aids will be two-way. This is achieved by providing the aids in programmed learning format. (In the early stages of development some of the aids may not be in programmed format.) The major emphasis will be on individualizing the learning situation. Each student's learning

Exhibit 3

Individualized Integrated Learning System


Learning Manager
Programmed Materials in Paper Form (Texts and Other aids)
Examinations to Determine Whether Learning System Meets Objectives
Sessions with Subject Matter Specialist & Learning Manager
Photographic Materials (Slides, Filmstrips, and Movies) with Student Response Mechanisms
Student
Other Learning Aids to be Developed in the Future
Electronic Video Recordings in Programmed Form
Computerized Programs for Individualized Learning of Segments of Material

stimuli will be tailored to his specific needs. His current level of understanding will be identified continuously and new information will be provided him as he is ready to assimilate it. The student will be constantly challenged while he is actively engaged with one of the learning aids.

The professor will become a learning manager. He will oversee and co-ordinate the learning system. The aids will be integrated so that each one complements the other aids. There is a synergistic effect in that because he is intimately involved with each aid, he is better able to improve the design of all the other aids. As the student is actively engaged with each of the aids, his responses to programmed questions can be recorded. These results, plus those derived from examinations and/or sessions with each student, may indicate to the learning manager that some of the components of the learning system need to be altered. The learning manager's task is to make the system as effective and as efficient as possible.

4.1 Characteristics of the Learning System envisaged through the Application of I. T.

4.1.1 Two-way communication between each aid and the student will be common, thus providing the student with immediate correction of incorrect responses, and immediate reinforcement of correct responses. This process also aids the learning manager in locating "weak spots" in his programmes.

4. 1. 2 Feedback from recorded responses during student interaction with aids, scores on examinations, and sessions with human resources causes the learning manager to alter various components of the learning system so as to achieve learning objectives.

4. 1. 3 The number of aids utilized in a given system is likely to be larger than under the present system. Resourcefulness and economics are crucial factors in determining the number and form of learning aids employed in any given situation.

4. 1. 4 The learning situation is individualized. Measurements are taken of the present state of each student's knowledge and capabilities. His needs and capabilities determine which aids can be most effectively employed, and at which level the student should enter each of the programmes. The content of the programmes comprising the aids is such that no two people are likely to proceed through the programme in the same way. The student's responses to programming questions determine the information that is next provided to him. He is provided with new and challenging information at each step through each programme.

4. 1. 5 <u>Time, rather than the comprehension rate, is the variable in the learning situation.</u> The comprehension rate achieved by each of the students will fall in a very narrow range. The time spent by various students, however, will vary considerably.

There will be less need for formal class sessions (although these probably never will be eliminated), and not all students covering a given segment of a discipline will be using the same type of aid at the same time.

5. KEY ELEMENTS OF I. D.

There are specific key elements to all systems of I. D., although they may be expressed in different terms. The following are the elements which will be described more fully:

5.1 Definition of environmental factors and organization structure.

5.2 Objectives

5.3 Testing, Measurement and Evaluation

5.4 Instructional Strategy and Learning Theory

5.5 Media Selection

5.6 Subject Matter Presentation

6. DEFINITION OF ENVIRONMENTAL FACTORS AND ORGANIZATION STRUCTURE

Environmental factors refer to the "setting" in which learning is affected. This setting may be defined broadly to include all of society or narrowly to include only the particular learning situation. The former definition has the advantage of making provision for all of the factors which could affect the educational system. The factors may be grouped as follows:

1) Characteristics of the student intake.

2) Existing programmes, their strengths, deficiencies and underlying problems.

3) The instructional setting, its constraints, and its latitudes for resolving underlying problems.

4) Financial and personnel resources available.

5) Organizational structure and the definition of areas of responsibility and lines of authority.

7. OBJECTIVES

The change in the learner occurs in terms of the curriculum learnt and is manifested by what he is able to do with that knowledge (i. e. performance or behaviour). The latter relates to a standard of performance and, therefore, the objective must be expressed in behaviourial terms which can be measured in observable attributes.

Briggs (5) has set forth in succinct terms, 21 reasons why written behavioural objectives are needed:

1. On a large materials-development project, written behavioural objectives serve as a basis for:

   a. assigning work to members of a team;
   b. reviewing the materials developed;
   c. organizing and managing the work;
   d. insuring unity of direction to the project;
   e. knowing when all draft materials are finished;
   f. conducting formative evaluation and revisions (empirical testing and revision);
   g. conducting overall summative evaluation and
   h. deciding on sequencing, selecting media, and prescribing for preparation of instructional materials.

2. To provide a basis for supervising the work of specialists; film makers, writers, artists, or evaluators.

3. To communicate to the user (teacher) the purposes of the completed materials, including evidence of effectiveness, so that the user can make a decision "to buy" or "not to buy".

4. To inform students of the purpose of each learning activity to guide both their study effort and self-evaluation of progress. To tell the student what he should be able to do upon completion of his study of a particular set of materials.

5. To know when a student has met "core" objectives, thus freeing him to use remaining time for enrichment experiences or self selected additional work.

6. To help students study selectively; to enable them to distinguish "core" from "enrichment" material in textbook or other materials.

7. To help review testing and evaluation procedures to make certain they are relevant and congruent with objectives.

8. To set milestones for reviewing progress, providing feedback on results, or to establish a basis for remedial instruction.

9. To avoid unnecessary guesswork or frustration for the student in directing his efforts toward appropriate goals, and to help him understand what basis will be used for evaluation.

10. To protect the teacher from unjustified criticism that exams (the teacher gives) are unfair, unexpected or irrelevant.

11. To guide the teacher in selecting individual items of materials if he must choose these rather than being able to purchase integrated packages designed to achieve specified objectives.

12. To remind each teacher to examine the appropriateness of his methods, materials and the use of class time.

13. To provide a basis for knowing when many students fail an objective (suggesting a need for change of objective or a change in method, or in materials); and/or when a few students fail, suggesting the need for individual remedial work.

14. To provide a reminder to review objectives periodically for usefulness and relevance, and to modify them on the basis of experience with the class or new information.

15. To respond to public inquiry about what is being accomplished.

16. To provide a basis for improvement of course goals through review with laymen and experts.

17. To provide a way to make partial course revisions in light of new data or changed conditions.

18. To provide a basis for grade placement of transient students.

19. To provide a basis for appraisal of assumed prerequisite skills.

20. To call attention to needed research on how to teach difficult objectives.

21. To serve as a basis for promotion, certification, vocational guidance, job placement, and for planning future educational needs of the student.

While the preponderance of literature supports the above reasons for well defined objectives, expressed in behavioural (performance) terms, there are knowledgeable people in the field who do not share this enthusiasm.

At the positive end of the opinion spectrum are those who say that the application of behavioural objectives, provided they are known to, and understood by, both learner and teacher, will significantly improve the effectiveness of any instructional programme.

At the other end of the opinion spectrum is the view that definition of behavioural objectives which demands precise delineation of small units of instruction, tends to be so narrow as to impose undue and harmful rigidity upon the instructor. This, according to Robert L. Docter, in

citing one of the more extreme views, "will result in cultural rigor mortis and inhibit the creative and innovative thrust of the human spirit for several generations". (6)

While the concept is not new, there has been a pronounced trend toward more precise definition in the use of behavioural objectives to the degree that some would say it has become a fad.

It is not unusual for people to react with extreme devotion to developments that capture their imagination. In these circumstances, expectations often exceed that which is possible or even desirable. Undoubtedly, there is danger in over-zealous reliance on the use of behavioural objectives. Docter has stated six consequences that are detriments. There are two that seem more valid than the rest:

> "In the behavioural objective approach, the answers are the only important aspect. The process is unimportant.
>
> The entire premise upon which this approach is based is rested in the importance of measuring the acquisition of the skill. Learning the skill is only secondary." (7)

While acknowledging the dangers and limitations in the use of behavioural objectives, one must also acknowledge the dangers and limitations in conventional teaching methods, along with its attributes. In the typical learning situation, the student relies on the teacher and his textbooks as his instructional resources. Theoretically, the student has almost unlimited sources of knowledge at his disposal, and can choose his own avenues of learning. Practically speaking, he is locked into the objectives which the teacher has established, either consciously or

unconsciously, but which are seldom known to the student, except by what is inferred in past examinations.

Moreover, and more importantly, there is no systematic basis on which the course given by the teacher can be evaluated for purposes of improvement and refinement. That does not mean to imply that courses are stagnant, but it is safe to say that progress in making improvement in the teaching and learning process is extremely slow, to which history offers eloquent testimony.

It seems, therefore, behavioural objectives are an essential element in any system that is designed to bring about continuing and consistent improvement in teaching.

Three types of behavioural objectives, distinguished fundamentally by time span to complete a task, can be identified. They are:

7.1 Programme Objective

This is the objective which specifies the level of achievement or degree of competence which all students are expected to achieve upon completion of the total programme. It communicates not only the required grasp of the subject matter included in the programme, but also what the desired behaviour of a student in programme will exhibit in order to achieve, as in the professions, certification.

7.2 Terminal Objective

A terminal objective is a sub-set of the programme objective which owes its existence to not only the subdivision of a pro-

gramme into subject areas, but also the subdivision of each subject area into major concept categories.

> "Terminal objectives are defined as major growth points in the cognitive, skill and effective development of students." (8)

In essence, a terminal objective is set at a point where either a subject area, a major concept category or a major topical sub-set is completed. Coverage of the subject matter is scheduled to be completed within a specific time span.

7.3 Transitional Objectives

A transitional objective is a sub-set of the terminal objective. It identifies the steps required in achieving complete mastery of terminal objectives, and may be defined as:

> "... short term behavioural objectives, that is concepts and skills to learn as prerequisites to the achievement of a terminal objective." (9)

As implied by the foregoing definitions, objectives can be broadly or narrowly set down in terms of course contents as well as in time. As objectives become more precise, more precise monitoring of student performance and programme effectiveness can be achieved. This was done at the New York Institute of Technology, and applied to a Programmed Mathematics Continuum Level I course. (10) This project will be referred to in greater detail under the section dealing with Testing, Measurement and Evaluation - page 46.

The underlying principle in specifying behavioural objectives is,

> "What do we want the student to do after the instructional programme that he couldn't do beforehand? Generally we keep this a secret -- we don't very often meaningfully communicate to him exactly what is expected of him." (11)

Several of those consulted in this study have stressed the importance of informing the learner at the beginning of the programme what the behavioural objectives are.

The task of writing explicit behavioural objectives in terms that will be clearly understood by the learner and the teacher is one requiring skill as well as a knowledge of the subject. It also requires considerable time. The classic "how-to" reference on writing behavioural objectives is the work of Robert F. Mager, "Preparing Instructional Objectives", published by Fearon Publishers, Palo Alto, California.

A potential source of prepared behavioural objectives for a wide range of courses is the Instructional Objectives Exchange. The purpose of the Instructional Objectives Exchange (IOX) is to:

> "Serve as a clearing house through which the nation's schools can exchange instructional objectives, thereby capitalizing on the development activities of other educators rather than duplicating such efforts.
>
> Collect and develop measuring techniques suitable for assessing the attainment of the objectives available through the exchange.
>
> Develop properly-formulated instructional objectives in important areas where none currently exist, that is, fill the gaps not covered by available objectives." (12)

At the present time, the value of the Exchange is primarily limited to the elementary and secondary school systems, but it is expected that in

the course of time, their catalogue will include objectives applicable to professional courses.

8. TESTING, MEASUREMENT AND EVALUATION

As in the other elements of the system of I. T., testing, measurement, and evaluation is in itself a technology. To borrow from the world of business, it is the operations research application to optimization of learner's time, instructional resources, and cost effectiveness. In the process, the following important functions are performed:

(a) The student is admitted to the programme at the level of his capability to continue with the rest of the programme, or he is informed of the subject matter in which remedial instruction is necessary for successful continuation.

(b) Student achievement is measured as he progresses through the course in relation to that which is expected of him at its conclusion.

(c) Data on student performance is used to evaluate the effectiveness of the instructional programme in relation to its objectives.

(d) On the basis of the data available, and on the basis of new knowledge in the application of instructional media, continuous refinements are made toward optimization in cost-effectiveness.

> "Measurement and evaluation are central to the operation and improvement of the instructional process because they reveal important things about pupil characteristics and achievement. They provide a valid basis for judging the worth and effectiveness of programmes and innovation." (13)

It must be acknowledged at the outset that the evaluation of an educational programme is a value judgement and therefore is beyond measurement. However, the precision with which value judgements can be made is directly related to the preciseness with which the standards and criteria are stated, and the quality of the data entering into the judgemental process.

> "---evaluation refers to the assessment of educational programs and their components with respect to the extent to which they achieve their stated goals and with respect to the cost (in time, money, effort or convenience) of achieving these goals. It considers the degree to which the program fosters or retards student progress, whether in subject-matter, skills and knowledge or in the formation of desirable interests, attitudes and personality traits. Evaluation may even extend to the assessment of the worthwhileness of the stated goals of a program but such assessment must be made more with reference to a philosophy of education than with reference to technological criteria." (14)

The major issue in measurement and evaluation is that of criteria, that is, what is the nature and degree of change that we expect of the student after he has completed the instructional programme. This is seldom clearly understood by the instructor and less still, if at all, by the student.

> "Many times failure occurs because the student doesn't know what he doesn't know. Procedures can be developed which could answer this problem, through the use of instructional technology." (15)

The first step in developing the system of testing, measurement and evaluation is the definition of objectives and performance standards as explained in the section under 'Objectives'.

There are a number of factors that influence the design of the testing system and the composition of the testing instruments. They are:

8.1. Norm-referenced or Criterion-reference measurement.

Norm-referenced measurement compares the performance of one student with the performance of others in a given group or class. It is grading by a "bell curve" in which a given percentage of the students are deemed to have been unsuccessful or to have failed in terms of the achievement of the entire group.

Norm-referencing fails to indicate objectively "how well" a student has assimilated information but rather measures a student's success in terms of the success of the group. In effect, depending upon the group into which a student falls, the success of that student can be a 'failure' or a 'success'.

Criterion-referenced measurement alleviates the shortcomings of norm-referenced measurement by relating the performance of a student to predetermined set objectives and standards of achievement.

> "---grading on the curve, if ever justified, is sound practice only when
> a. a clear standard of acceptable performance is established and the grades issued are referenced to this standard; and when
> b. a given letter grade has a stable meaning over a period of time, regardless of the group to which the student is assigned.
>
> It may further be observed in this type of norm-referenced grading, the tests employed are often deliberately designed

to exaggerate the size of the differences among students. When no instructional objectives have been stated, and there is no way to judge the validity of the test, and no way to set a score for "passing", test makers often "go for the highest possible reliability and discriminating power" by the way they make and remake the test. They may do this by sampling the content of the materials rather than sampling performance relevant to a stated objective. Then, if the first distribution of scores are not "normal" (bell shaped), they may introduce a different mixture of "difficult", "easy", or "medium" items to "smooth out the curve." ... concepts of "item difficulty" and discriminating power are irrelevant to criterion-referenced testing procedures."

"When objectives are well defined, and when clear, reasonable performance standards are set for appropriate minimum test performance, it is then possible to realize many benefits." (16)

It is possible to set as an objective, that 80% or 90% of the students will answer correctly 80% of the questions, with no student giving less than 60% correct answers. Thus, a student fails due to his lack of performance and not in relation to the performance of others as with the bell curve.

"What <u>can</u> happen, under a self-paced individualized program is that <u>all</u> students may equal or surpass the minimum standard for a given objective, even though <u>time to meet the standard</u> may happen to be distributed in accordance with the normal curve." (17)

8. 2. <u>Pretest</u>

The pretest attempts to measure the achievement level of the students entering the programme, and to indicate at what level he may be admitted with reasonable assurance of his capacity to successfully master the remainder of the instruction.

The pretest can also identify the topical areas of the subject matter in which upgrading is necessary. By concentrating on those areas, the student can optimize the use of his time. Relating the results of the pretest with the student's performance in the programme and on the post-test can be the measurement of its effectiveness in predicting outcomes. With continuous refinement in the design of the pretest, it should be possible to achieve an acceptable degree of accuracy in projecting probable student performance, thus making it possible to tailor the programme to individual needs.

8. 3. The practice test

The practice test is the means by which the student can determine his mastery of the subject matter. Not only is it measurement of the student's progress but it should, of itself, be an instrument of instruction and learning. The immediacy and quality of the feedback to student responses to test items are an essential element to the effectiveness of the instructional process.

Feedback may be provided through immediate confirmation of the correctness of the student's response, or by directing him to additional material for further remedial study, as in programmed learning; or by providing a model of the expected answer for self-evaluation; or by a direct statement by the

instructor as in a classroom situation.

In any event, the reliability and validity of the testing system should be such that the student will know with confidence that he has reached the necessary achievement level to proceed to the next stage. Moreover, as he progresses through the programme, his performance in the practice tests should be a reasonably accurate indication of his probable performance in the post-test.

The practice test is an essential element in the process of evaluating the effectiveness of the instructional programme. In the development of new programmes, and in the refinement of existing programmes, the analysis of student responses is used to modify and shape the programme to yield the best results. In the terminology of Scriven (18) this is "formative" evaluation as compared to "summative" evaluation which is related to the degree of acceptability of the final product.

8. 4. The Post-test

The post-test evaluates the student's mastery of the subject matter in relation to the objectives of the programme completed, and it is a measure of his competence to proceed to the next course in the curriculum sequence. It should also be a measure of the effectiveness of the programme itself as stated by Briggs (19).

In an educational programme for professional certification, the post-test is usually an examination taken by all students at a specified time and place under tight security arrangements. This means that the advantages of a self pacing individually prescribed programme of instruction are severely limited by the constraints of the the examination schedule. The question arises: Is it possible to design the pre-test and the practice tests with such precision that, assuming the student is honest with himself, he could proceed through a series of course sequences in a subject area with reasonable assurance of his ability to meet the required standards of performance in the final examination? While there were no references or experiences examined in the course of this study that would either confirm or negate the feasibility of such a plan, several authorities in the field of measurement and evaluation expressed the view that the plan was feasible theoretically. Only a comprehensive test case would provide needed evidence.

8. 5. Monitoring student performance and programme effectiveness

In any system of analyzing student performance and programme effectiveness, it is necessary to relate the test items to the behavioural objectives which have been prescribed for the programme. The smaller the units of measurement,

the more precise the measurement, and the finer the degree of analysis that is possible. With the use of the computer, the intelligent application of principles of educational measurement and evaluation can give assurance of student attainment to a higher degree than was previously thought possible. To be specific:

" 1. Because of its capability for storing and analyzing student responses, the computer will facilitate the "item analysis" of instructional content and the tryout and revision of instructional programmes. Already at the University of Illinois, it is standard procedure to print out daily error analyses for computer-course authors, who then try to revise their programme to reduce student error.

2. The computer is an enormously convenient testing device. It can in the first place rather quickly diagnose the student's initial state of knowledge about a subject matter, "branching" him either to easy or difficult material according to his needs. In the second place, it administers quantities of test materials in the course of an instructional program; the student is not allowed to progress through the program unless he demonstrates mastery at intermediate points.

3. The computer can accumulate and analyse data on large numbers of students -- data on student characteristics, learning performance, backgrounds, etc. It would thus facilitate the evaluation of different instructional programs and the tabulation of the results.

4. Specialized capabilities may be developed whereby computers can evaluate free responses of student as validly, and more efficiently than they can be evaluated by teachers. Work is now going on at the University of Texas whereby students' answers to essay questions in science courses can be quite accurately scored by computers. " (20)

One of the most comprehensive procedures for testing and evaluation is that developed at the New York Institute of Technology in their Programmed Math Continuum (PMC). (21) The PMC is a full year course divided into 18 major units called Volumes, each of which is divided into five segments. For each segment there is a Terminal Objective (TO) and prerequisite to each TO are a varying number of Enabling Objectives (EO). The TOs and the EOs comprise the list of Measurable Behavioural Objectives (MBOs). For ease of reference and for analysis by the computer monitoring system, each MBO has been assigned a five digit code number, e. g. consider MBO number 1 8 3 2 1 This indicates: 18/ 3/ 2/ 1

VOL 18 SEG 3 TO 2 EO 1

Each test item is related to a specific MBO and is identified by the corresponding code number. The computer analysis of each student's responses is possible by relating the question to a specific MBO and each erroneous answer choice to an Error Concept Catalogue. The Concept Catalogue is a coded listing of concepts and skills. It is used to indicate the probable error that a student made in answering the question. It is distinct from the MBO to which the the question is related.

> "The Testing Program associated with the PMC includes a Test A and a Test B for each Study Guide Volume as well as a Midterm Examination (in two forms) and a Final Examination (also in two forms).

"1. The Criterion Checks are affected by the verification of the correctness of the response and the assumption that a correct answer indicates the mastery of the MBO associated with that question.

2. A compilation of all correlations between the questions and the MBOs as created by the course writers is presented in the MBO Cross Reference List. ---Each study Guide Question, Homework Assignment Question, Pre-Test Criterion Check, and Post-Test Criterion Check is correlated with an ordered listing of the MBO Code numbers and the Concept Catalogue.

3. The computer maintains a file with similar information. However, it is ordered by question number, rather than MBO number. This file, called the Question File, is the master key for selection of printout information to be supplied to the user dependent upon the correctness of the answer choice.

4. Test B can be employed as a screening device (pre-test) for permitting students with previous experience in the subject matter to be exempted from the remaining materials in that volume.

5. Test B can be used to form a basis for determining learning increment as evidenced by performance on Test A (post test) subsequent to the study of the volume.

6. For students who have no previous experience in the subject, Test B can be used as Pre-Test following the remedial work done after taking the post-test." (22)

The description of the system goes on to explain the method by which individual remedial programmes are prescribed.

8. 6. Storage and retrieval of test items

Usually there are few rather than many examinations given during an instructional programme. The preparation of tests and the scoring takes a considerable amount of time, if the tests are to be

valid and reliable for purposes of measurement and evaluation. I. T. provides the means whereby this problem need not exist. The only problem is in supplying items in sufficient quantity and variety to relate to all the objectives in the instructional programme. The computer can be the repository for such an item bank; it can create a composite of questions on the basis of a test item model; it can collect, file and retrieve all questions ever used on tests. What is more, data on what students do with these questions can be stored and analysis information can be given the student. The programme author can also obtain such data indicating where the students are having problems.

9. INSTRUCTIONAL STRATEGY AND LEARNING THEORY

Instructional Strategy refers to the act of deciding in what manner objectives will be achieved. It is a process of selecting or choosing a "modus operandi" from the viable alternative choices of action which vary in scope, timing, emphasis, allocation of resources and contribution to the end results.

As C. R. Carpenter put it, in determining strategy, we are asking the questions, who does what? What does what to whom and with what effect in terms of learning behaviour?

> "The major problems, it seems to me, are decisions about what roles and what functions can be served or mediated by people, by instrumentation, by conditions, by the internal controls and self activated regulated contingent efforts of the individual learner himself.
> I think that the controversies about the roles and development of instrumentation or the roles and

> development of people are beside the point. Both are required. It is rather a question of what specific roles can be most appropriately carried out by which people or what things or what instrumentation. I think of the ideal condition as being a direct interaction between the learner and the selected organized stimulus material or displays. Intervention between the learner and this stimulus material by any interference, including teachers, is undesirable." (23)

It must be said that the task of arriving at the configuration of the media forms to achieve optimum effectiveness in the learning process is the most difficult part of the entire process of I. T. This is simply because there is not enough known about the relative effectiveness of the different kinds of stimuli to learning.

> "There is a consistent attempt by a number of researchers and theorists to discover the unique attributes of instructional media and their relationships to the performance of particular psychological functions with different kinds of learners. The study of this three-way interaction of stimulus, task and learner is extremely complex, but some evidence is building up that could lead to more precise understanding of the place of media in the instructional process. --- The time is far off, if in fact it ever arrives, when we can identify an instructional problem and then faultlessly select the proper instructional mix to solve it. Yet the significance of the present research is that careful investigation of the design elements in mediated instruction are being made and that these searches are being conducted within a theoretical framework, thus laying a foundation for a theory of instructional media." (24)

In its most general sense, learning is the process of adaptation based on experience; an experience founded in symbols such as words, gestures and pictures.

While the field of learning theory appears to be a maze of contradictory jargon, there is a core of basic agreement on some of the important

aspects of learning. There are many learning theories but only four have gained substantial recognition. These four are:

1. Connectionists - this theory is based on the stimulus - response psychology. Learning is gradual and when the learner is stimulated, the effect will determine the nature of the response.
2. Cognitive and Perceptual - the learner must discover through personal experience from which he will derive meaning.
3. Imitation - identification - this theory states that learning is based on example and emulation. Sigmund Freud's work forms much of the basis of this theory.
4. Equilibrium Theory - this theory states that learning takes place by manipulation of forces on the student.

On the surface these four theories seem far apart, but researchers have examined the theories carefully and found that all theories contain the following common principles which affect the learning process.

1. The Principle of Reinforcement - the learner should have feedback to know when he is right in his responses.
2. The Principle of Participation - the learner should be part of the learning action - not always a passive entity.
3. The Principle of Discovery - the learner should be allowed to discover principles and relationships, rather than have someone always state these parts.
4. The Principle of Motivation - there should be a positive motivation for learning.

5. The Principle of Meaningfulness - the material should have a meaning that can be identified with reality or with reason.

6. The Principle of Sequence - there should be a goal at the end of a learning experience and the material should move logically toward that goal.

7. The Principle of Transfer - the basic concepts of the material should be taught so that these concepts can be transferred or applied to a variety of situations.

Although these principles indicate that learning is an individual matter which is largely dependent upon what the student does, learning can take place in a variety of situations and with a variety of media which can influence the effectiveness of the learning process.

Besides learning theories, there are theories of communication, of utility economics, of psychology, of body chemistry and other sciences which are all pertinent to the effectiveness of learning, but beyond the scope of this report. In addition to the theories that affect learning it is recognized that with any set of students with essentially equal intellectual capacity, there will be a variety of effectiveness in learning because of constraints of such factors as environment, cultural background and maturity of students.

It is possible to illustrate and to state the optimum learning experience (See Exhibit 4). While Exhibit 4 may seem theoretical it over-simplifies the area of learning effectiveness but it seems to illustrate that in the whole realm of I. T. one must be very careful to recognize the inter-

relationships of the constraints and the theories. For instance: given a certain type of student and a certain subject matter, the principles of reinforcement and transfer may be much more important than the other principles and as such will have a large influence on the choice of media used to teach the course.

We find that subject matter has been classified so as to give some guidance as to the best choice of media. As in the realm of learning theory, there is no common agreement on the terminology that should be used in the subject classifications but, in essence, there is much in common. One such classification that has been used to segregate the subject matter that is found in accounting curriculums is as follows:

1. Concepts - which cover the basic terms and definitions.

2. Techniques - which deal with application and procedures.

3. Structured Problems - where there is analysis and the application of a specific solution.

4. Unstructured Problems - where analysis is required to define a problem with many dimensions and which requires the integration and synthesis of different types of knowledge and skills to obtain a satisfactory solution.

If one looks at these four classifications of subject matter and relates them to Exhibit 4, it can be readily seen that the best medium of instruction used to teach each type of material could be different and that the various principles of communication and learning will have a different relative importance depending on the type of subject matter and the student.

Exhibit 4

Main Principles in Learning Theories

X - Variables / Y - Constraints	X_1 Principle of Reinforcement	X_2 Principle of Participation	X_3 Principle of Discovery	X_4 Principle of Motivation	X_5 Principle of Meaningfulness	X_6 Principle of Sequence	X_7 Principle of Transfer	X_8 Communication Theories	Behaviourial Theories
Goals of Course Y_1									
Student Background Y_2									
Subject Matter Y_3									
Media Used Y_4									
Y_5									
Y_n									

One may state theoretically that optimum learning takes place when the ideal balance is found in matching the X - theory variables with the Y -input constraints. Mathematically this could be stated:

$$OE_o = f(Xi, Yi)$$

where OE_o = optimum learning experience and where X and Y represent the factors designated in the grid above.

10. MEDIA SELECTION

Media selection is simply a decision predicted upon choosing one of a variety of presentation forms founded in an audio and/or visual combination arranged in a particular fashion to stimulate viewer participation. However, because of the variety of vehicles available, in considering the selection of media, there are certain fundamental principles that should be recognized:

1. Media selection is an integral part of designing the instructional system.

2. The choice of a particular medium must be determined by its relative effectiveness in presenting selected material and in achieving desired behavioural objectives. Media should be adapted to the programme, not vice-versa.

> "Given the inputs of behavioural objectives and environmental information, presentation design theory will be used to prepare one or more presentation forms for those inputs. Then media selection may proceed, considering the medium's limitations in conveying the presentation form intact rather than some unsupported advantages claimed for it." (25)

3. In a multi-media system, each instrument must be considered in relation to its particular role within the total system.

4. Where a standard programme is being used in a number of locations, the equipment and the material must be compatible.

5. The message to be communicated and its effect upon the learner are the dominant factors. Gadgetry should never be allowed to submerge the substance of the presentation.

6. When one speaks of media, one usually associates it with mechanical devices. Among media, the book is still paramount. The blackboard and chalk, paper and pencil, and the teacher himself are the most important in terms of generality and flexibility.

7. Consideration must be given to the physical characteristics such as: flexibility, accessibility, reliability, scheduling, maintenance, complexity and standardization.

8. Cost-effectiveness will have a bearing on choice of media. Cost not only includes the capital investment, but also the maintenance and supplies. Cost can be established fairly easily. Effectiveness is much more difficult to ascertain.

9. The effectiveness of instructional devices has to be measured over a period of time as the initial novelty will increase concentration and stimulate interest. Will this interest and concentration be sustained as the novelty wears off?

10. Media are not only the vehicle for presentation of the message but, when necessary, they are also the vehicle for feedback and evaluation.

According to Briggs et al, the procedures for selecting instructional media are:

> "1. State the behavioural objectives for the course or unit of instruction in the sequence in which they should be taught.
>
> 2. For each objective, identify the types of learning involved.

"3. Using required conditions of learning as a guide, design a "media programme" for each objective which lists the instructional events, identifies the characteristics of required stimuli, and states the media options which should be acceptable.

4. Prepare a summary of the media options for a group of objectives making up a sequence of instruction, and scan these to identify frequently occuring media options.

5. Assign the media in which the instruction should be packaged to achieve the best trade-off in respect to effective stimulus display, convenience in changing from medium to medium, and economy in terms of size of unit in which each sequence is to be prepared in the given media.

6. Write specifications for the preparation of the instruction by the various media producers." (26)

The authors provide a detailed discussion of each step to show more fully the significance of each step in reaching the media decision.

For purposes of review and assessment, media may be classified into groupings.

> "Media overlap in their capabilities, are interchangeable to varying degrees, and are used in various combinations under different circumstances. The selection of media for (this) study is, therefore, to some degree arbitrary. The selection is based primarily on what has emerged in the past ten years as innovative groupings and on the devices which are grouped in ongoing research. Within certain groupings (e. g. Dial Access Information Retrieval Systems), there are various subclassifications which are different in terms of instructional flexibility, support requirements, and/or cost. The media categories and subclassifications included are listed below.
>
> a. Portable Instructor Aids
>
> - Overhead Projector
> - 35 mm Slide Projector
> - 35 mm Filmstrip Projector
> - 8 mm and 16 mm Motion Picture Projector
> - Audio Tape Recorder

b. Student Response System

- Audiovisual control
- Teacher-student Feedback
- Individual Feedback

c. Programmed Instruction Text

- Linear
- Branching

d. Teaching Machines

- Linear
- Branching

e. Learner-Centred Audiovisual Devices

- Sound Filmstrip (Audiotape)
- Sound Filmstrip in Cartridge
- Sound Motion Picture

f. Simulators

g. Advanced Applications and Concepts

- Dial Access Information Retrieval System (Random Audio/Video)
- Computer Assisted Instruction
- Electronic Video Recording (EVR)
- Teaching Machine with Branching (Motion Picture)" (27)

As mentioned previously in this report, there are continuing refinements of existing devices that will greatly influence media choice for a particular situation. For example:

> "What is here right now is the Kodak Ektagraphic MFS-8 Projector. This machine will project individual still frames of a super 8 motion picture for as long as the user wishes. Or, press a button, and the projector shows the film at normal movie speed. The dimension of sound is available through a co-ordinated cassette tape recorder with a binaural track. This means that in the very near future, we can program learning situations in which a computer can present

> "the student with written and verbal information and through an electronic signal, trigger the action of the MFS projector to show either "still" or "motion" pictures.
> ---A single 50 foot roll of super 8 movie film contains as many separate still pictures as would a 3, 600 frame filmstrip," (28)

> "The key to the selection of the appropriate instructional media to use in any particular teaching situation is the relative effectiveness of that medium in accomplishing the desired educational objectives." (29)

Most research on media has focused on the relative effectiveness of one medium as compared to another. There is very little research that would provide a solid base for prescribing the medium that will best achieve the desired objectives under given conditions. However, Dr. Allen (29) has provided a useful guide in his article referred to above and which has been adapted for the purpose of this study as shown in the following:

Instructional Media Stimulus Relationships to Learning Objectives

Inst. Media Type	Learning Objectives: Learning Facts	Learning Principles Concepts Rules	Learning Procedures	Performing Skills	Develop Desirable Attitudes Opinions Motivations
Still Pict.	Med.	Med.	Med.	Low	Low
Motion Pict.	Med.	High	High	Med.	Med.
Tele.	Med.	High	Med.	Low	Med.
Audio Rec.	Med.	Low	Med.	Low	Med.
Prog. Inst.	Med.	Med.	High	Low	Med.
Demonstrate	Low	Low	High	Med.	Med.
Printed Text	Med.	Med.	Med.	Low	Med.
Oral Presentation	Med.	Med.	Med.	Low	Med.

As seen from the foregoing guide, the use of films, projected still pictures and television in the presentation of factual information adds little to the effectiveness of oral or print presentation. However, they do contribute to interest level through a variety of presentation, and reduction in unnecessary repetition.

Unfortunately, media research has produced very little solid information that can be used as a base for prescribing a particular medium to achieve desired behavioural objectives, with the possible exception of programmed instruction. Such studies as have been made to determine the relative effectiveness of one medium against another have been quite inconclusive. In the comprehensive report on Instructional Media by Briggs, Campeau, Gagne and May (26), a number of reasons are cited for the uneven quality of experimental studies. One of the most prominent factors is the lack of attention to content when making comparisons of media effectiveness. For example:

> "...in film research, the typical comparison is between conventional methods and instruction by <u>some</u> on-the-shelf item." (26).

One wonders if the results would have been different if the film had been tailor-made to the required objectives. This is undoubtedly one of the contributing factors to the high incidence of "no significant differences" in the stated outcomes of comparative effectiveness studies.

With the exception of programmed instruction, it would be misleading to draw general conclusions from the comparative effectiveness studies that have been made. The number of variables that influence outcomes are so

great as to make definitive statements quite hazardous. Meaningful conclusions can be drawn only when there is a similarity of characteristics in the subject matter, programme content, objectives, conditions of learning and in the learners themselves.

For example, in a number of studies made, there was a preponderance of no significant differences in the use of filmstrips, slides and transparencies with other media, e. g. lecture, still pictures, motion pictures. Yet a study comparing the use of transparencies to the use of chalk-board for teaching engineering drawing did find significant differences in favour of transparencies.

Practically all communications media can be used with varying degrees of effectiveness for all instructional events, but some media are more effective in achieving certain objectives than others. It is the arrangement of instructional events and the configuration of the media in relation to desired objectives that determine the degree of instructional effectiveness.

Robert M. Gagne makes some general observations that may serve as useful guidelines. As he points out, "they are not the answers, but merely the basis for further investigation of the uses of media."

> " 1. First, no single medium is likely to have properties that make it best for all purposes. There is, so far as we know, no special magic in any particular medium.
>
> 2. Second, the most important single criterion for a choice of medium is often the nature of the learning task itself - that is, the objective of the instruction. If the learner is going to respond to real objects, these need to be used at some point in instruction. If he is going to respond to auditory language, then this form of

communication needs to be used at some point in his instruction. However, it should be noted that this criterion doesn't solve the whole problem by any means. The reason is that for many objectives, one medium is as appropriate to the task as another.

3. Third, when one considers the functions of instruction, it is evident that any given medium may perform one of these functions best at a given time during a period of instructing, while another medium may perform an instructional function best at another time. That is to say, the precise answer to the question of which medium is not to be found by matching courses with media. Within a given topic, for example, attention might best be maintained by the introduction of pictures, whereas guiding learning might best be accomplished by printed or verbal instructions, and feedback might best be performed by auditory language. ---When one chooses a particular medium for a whole course, or even for the development of an entire topic, one is usually making a judgment that such a medium will be best suited "on average" for the various instructional functions it must perform.

4. Finally, there is another suggestion to be derived from these considerations about the instructional functions of media. It may be that the most striking effects of instructional planning are to be sought in various combinations of media, where each may perform a particular function best." (30)

In addition to the need for meeting required instructional objectives, there are other factors that will govern the choice of media. They are:

1. Environmental conditions or the setting in which the media are to be used, i. e. for individual study and instruction either in the home or in a learning centre; for small group workshops; as instructor's aids in small groups or in large classes.
2. Instructional flexibility; that is, the number of ways in which facilities may be used.

3. Compatability with the materials to be used. This is essential when standard materials are being used in a large number of centres.
4. Student response and feedback mechanisms.
5. Capability of accumulating data for management control purposes such as diagnosing student problems, identifying programme deficiencies and measuring student progress.
6. Cost of equipment and support requirements in relation to its effectiveness.

The wide array of equipment available makes the task of selection a most difficult and complex one. Moreover, there are continuous refinements being made and new ideas are being introduced. A particular device may not be acceptable for a given situation today because of its characteristics or because of cost, but tomorrow it may be admirably suited on both counts.

Where the emphasis is on individual study, the ideal arrangement would be for each learner to have his own facility in his own home. There is now available, at acceptable cost on a purchase or lease basis, audio visual equipment with student response and feedback mechanism that could be acquired for home use as well as in a learning centre. For example, the Borg-Warner Corp. has developed an audiovisual system that will probably sell for under $400. It consists of an electronic unit resembling a small television set, a colour film slide and a record synchronized with the slide. Five buttons enable the student to select correct answers and advance the lesson; a wrong answer causes the machine to repeat the instruction and

the question. It has a branching feature that enables it to adjust to the ability of each student.

Another development which brings teaching into the home is the telephone system which is linked into a central teaching unit. The terminal unit consists of a small push button panel similar to that which is on the telephone instrument. The student can select the lesson he wants at the time of his own choosing and the instruction will come back. At the conclusion of the lesson, the student is given multiple choice questions to which he responds by pushing the appropriate button as he would on a teaching machine. A correct answer will advance him to the next lesson. A wrong response will result in additional information to reinforce the instruction and then direct him back to the question. His responses are recorded and accumulated for analysis.

Many universities and colleges are now equipped with learning centres for self instruction. Individual study booths are equipped to use carrels that have been prepared for specific lessons. The drawback to this system is in the fact that the equipment in each centre may not be able to accommodate the standard material which has been produced for the course.

Video tape playback systems are now available for home use. While the cost at the present time is restrictive, it is estimated that within five years the playback unit will be as common in the home as the TV receiver. The introduction of the super 8 mm film has greatly enhanced the flexibility of this medium.

The most publicized and dramatic element of technology in education has been the application of the computer. The computer has a variety of uses in education, but those that are particularly relevant to this study are:

10. 1. Computer assisted instruction (CAI) The computer and student interact with the computer performing an instructional role in the form of drill, practice and tutorial with branching characteristics. CAI also embraces gaming and simulation. Interest in CAI has declined substantially, largely because of the very high cost. Even recognizing the possibility of substantial cost reductions through improved design, it has yet to be established that the instructional or learning effectiveness of a computer in the role of a tutor is any better than a teaching machine or printed programmed instructional material. In the words of Dr. Oettinger, "the computer is a very expensive substitute for turning pages."

10. 2. Computer managed instruction (CMI) CMI has a wide range of applications, all of which are directed to optimization of instructional systems. In a professional organization, with its comparatively limited objectives, the use of CMI is likely to be restricted to processing and manipulating management information for testing, evaluation and analyzing student performance and programme effectiveness. Significant advancements are also being made in the use of the computer as the link in dial access to instructional programmes.

10. 3. As a problem solving device. The computer is used extensively for solving complex problems in such courses as quantitative analysis, statistics, business decisions, and in the use of mathematical models.

On the basis of evidence now available and indications for the future, computer applications to programmed instruction for the accounting profession is not feasible and further discussion does not seem warranted. It does have an important role in simulation and games and in the transmission, storage and retrieval of performance data.

Because of the wide choice of media available and the constant change in the state of the art, it is necessary to rely on the services of a media specialist, in co-operation with other specialists, to prescribe the medium, or a combination of media, best suited to a given situation.

11. SUBJECT MATTER PRESENTATION

The critical element in the entire instructional system is the presentation of the subject matter in a manner that fully exploits the advantages of available media in achieving the desired objectives. In the jargon of the trade, it is the "software" that counts.

> "A student does not learn from the media. He learns from the presentation form. Media do little more than deliver the information to be learned in whatever presentational form previously decided upon." (31)

Not only is the instructional material and its forms of presentation the critical element, it is very often the weak element. It is the element that had contributed most to disenchantment with, and resistance to, the application

of technology to the instructional process. This is particularly true in higher education, and it is to this level of the educational system that the following comments apply.

The literature on the subject of instructional technology is replete with references to the deficiencies of instructional material in both quality and quantity. Among the many reasons given for this deficiency, the most significant are:

1. Very often existing instructional material is simply transferred to that media which will save time for the instructor, or which will accommodate a larger number of students. In doing so, the existing teaching programme is put on record with all its imperfections. The imperfections tend to be emphasized rather than minimized, added to which are any imperfections in the medium itself. For example, an audio tape picks up poor speech and poor delivery but it does not pick up the personality of the speaker which sometimes more than compensates for poor delivery.
2. A piecemeal approach to instructional development. The design of the instructional materials must be planned in relation to the behavioural objectives desired, the testing system to be used, and the medium or combination of media that have the greatest potential for the optimum in cost effectiveness. To deal with one element in isolation is to invite consequences that could do more harm than good.

3. The time required of an instructor to write a programme to fit the system is considerably greater than that required for a typical lecture.
4. There is no system of rewarding an instructor for the writing of an instructional programme that, once produced, might well have widespread use, nor are there funds available for acquiring technical assistance in such ventures.
5. There is an understandably strong desire on the part of university teachers to present their own subject matter in their own way. Unfortunately, few teachers have the characteristics and the skills to exploit the advantages which various media have to offer.
6. Most instructional material is not subject to a system of reliable and valid testing and evaluation. Therefore, there is no basis for diagnosing deficiencies and for systematic refinement and improvement.
7. The cost of producing quality programmes tailored to specific needs is usually excessive in relation to the number of students to be served.

Having identified some of the more significant reasons for the lack of quality instructional material, one must also acknowledge that, while much has been written on instructional and learning theory, there is relatively little literature that deals with the application of theory to practice. How do you design a programme with some assurance of the outcomes? Generally, it

is a case of "if at first you don't succeed, try, try again." More frequently what happens, is, if at first you don't succeed, the whole idea is rejected either from lack of desire or lack of funds.

From the literature which has been gleaned and the discussions held in the course of this study, some useful guidelines have emerged that should circumvent some of the problems mentioned and should contribute to the development of instructional programmes with predictable results.

First, it is assumed that behaviourally-stated objectives are established and that valid and reliable test items have been prepared in relation to the objectives. This assumption is immediately open to question. While it is relatively simple to write behavioural objectives for learning facts, principles and procedures, how does one specify outcomes in terms of student behaviour when dealing with complex types of learning such as problem solving? It is this type of learning that is most dominant in higher education. Therefore, it must be recognized that one of the major problems in instructional design for higher education is the difficulty of specifying complex objectives.

Dr. M. David Merrill has suggested an interesting approach to this problem based on certain presumptions.

> "Premise: It is presumed that there is a limited number of different kinds of behaviour and that any instructional outcome is an instance of one or more of these behaviour classes.
>
> This means that a given educational goal or objective can be classified into one or more behaviour types. Conversely, each educational objective is not unique in itself but is similar to a set of other educational objectives in terms of the kind of

> " behaviour change required. Further these classes of behaviour run across subject matter lines. That is, objectives can be identified in English, Mathematics, science, social sciences, home economics, auto mechanics, and physical education which are similar or identical in terms of the kind of behaviour they require.
>
> ---The behaviour classes identified can be arranged in hierarchical continuum. That is, the behaviour at one point in the continuum requires as a prerequisite some behaviour in each of the previous classes----" (32)

However, there still remains the critical task of designing the information processing strategy and the production of the programmes to be used. This must be the product of a team effort co-ordinated by an instructional technologist who is knowledgeable about instructional systems, the various techniques and learning theory. The composition of the team will depend upon the particular task and individual preferences, but generally speaking, it should include the following:

A subject matter specialist, usually the course author.

A media specialist, i. e. one who is conversant with the comparative attributes of the various media.

A behavioural scientist or educational psychologist who is able to articulate, in behavioural terms, the learning objectives.

The team should be responsible for planning the configuration of instructional activities, but it is essential that the production of materials for the different activities be assigned to those with the requisite skills. While this may seem so obvious that it does not deserve mentioning, yet it has been shown repeatedly that instructional systems have foundered because of the deficiency in the quality and effectiveness of the presentation of the

subject matter. It is the underlying cause of the high incidence of "no significant difference" in experimental programmes. The preparation of visual material for slide presentation requires a different skill than that for motion pictures. The writing of material for printed programmed instruction is quite different from writing a script for use on an audio tape or for a commentary to be used with film or slides. Even in the use of a particular medium, the desired objectives may require differing qualities on the part of the producer.

> "Educational film and ITV makers should follow neither the techniques of the lecturer, nor the technique of the entertainment procedures, but develop a new form based on a knowledge of learning conditions." (33)

Commercial firms producing instructional materials recognize all this and consequently the best materials in terms of creativity and quality of production are produced by them. However, there are two problems associated with the use of commercially produced programmes. First, they are produced for the mass market and therefore do not always fit the objectives of a particular course. Secondly, it has been acknowledged by many of the firms that their programmes have not been subjected to valid testing to determine if they do, in fact, achieve the objectives claimed for them.

Notwithstanding the practical problems of cost-effectiveness in producing tailor-made programmes, some significant gains can be made at relatively low cost. This can be achieved by accepting the fact that the degree of effectiveness has to be related to cost that can be justified

economically, or by expanding the market for the product. This means to say that, quite frequently, significant gains can be made at a relatively low cost, albeit, greater effectiveness could be achieved with a higher cost product. For example, in meeting certain objectives, an audio tape can produce significant gains over a conventional lecture even though film or video tape with sound may be the most desirable. It has been established that a typical lecture can be reconstructed to provide the same degree of effectiveness in imparting the subject matter, but in considerably less time. At Michigan State University, experiments have shown that a typical lecture can be reduced by 2/3 through effective editing, with no significant difference in recall of basic facts.

As pointed out previously, an important factor in cost-effectiveness is the number of students to be served. If standard programmes were used by a large number of teachers, good quality production would then be economically feasible. This is not likely to happen in higher education for the reasons already mentioned. The problem is less acute in those situations where there is a high degree of centralized control of educational programmes in which large numbers of students are enrolled such as in the military, in government and in some industrial programmes. To a degree this also applies to professional education.

A possible solution to this problem over the long term came to light in discussions with Dr. Dale Taylor, Prof. of Accounting, Graduate School of Business, Brigham Young University. Dr. Taylor proposes to experiment with the development of "performance modules". A module is a unit of

instruction necessary to achieve the desired behavioural change in a single topic of a course. Three kinds of behavioural change are intended: conceptual understanding, problem solving capability and attitudes. The instructional programme for each module will be designed as a complete package, i. e. terminal and enabling objectives in behavioural terms, pre-tests, practice tests and post tests identified with the objectives, and the instructional materials. It is his hope that other institutions would adopt this plan and form a central clearing house or "module bank" which instructors could draw upon. This means that each instructor would select those modules which would fit his course syllabus. Each student could have access to this material at his convenience. With the increase in the variety of learning resources on a modular basis each student could plan the learning strategy that best suits his individual characteristics. The benefits of this plan would be realized over a longer period of time and simultaneously the number of users would likely increase.

When discussing with teachers the application of technology to instruction there is invariably an assumption on the part of the teacher than the human element is being completely subordinated to the mechanical. It must be emphasized again that the teacher is still part of the instructional system although, in some situations, his role will change. The nature of the change will depend on the subject matter being taught, the level of learning, and the objectives to be achieved. Moreover, technology, when used imaginatively by the teacher, can be a much more effective means of achieving certain behavioural changes.

For example, a video tape of a student's performance in a certain activity can be far more effective in influencing that student's behaviour than anything an instructor might say. This technique referred to as "mycroteaching" is employed in the education of teachers, doctors and lawyers. A law student can see himself in action presenting his case before a simulated court. When his performance is analysed by the instructor, the video tape speaks with more effectiveness than the words of the instructor.

The enactment of a case problem on film or on video tape can portray attitudes and personal characteristics that often influence judgments and reactions but which cannot easily be described in a written case.

A technique called Video Audio Participation (VAP) has been tried in a course in management at the Graduate School of Business, University of Georgia. (34)

> "The VAP system includes several key physical components. The first is a sound motion picture which provides the mechanism for simulating business experience. Film and case method are combined into a filmed case. This film is used to create a business environment with which the learner could inter-act as a role-playing participant.
>
> The second component in the VAP system is an electronic response system. This allows all learners to participate concurrently. Such equipment enables students to respond to questions and comments directed to them by the film characters, and to questions from the instructor. A large selection of these latter questions was projected from slides which became the third component of the VAP system."

Summary:

In the foregoing an attempt has been made to direct attention to the following points in the design and production of instructional materials:

1. The design and production of instructional materials must be undertaken within the framework of the total system.
2. A team approach is essential if the objectives are to be achieved and if the advantages of the available media are to be maximized.
3. While cost is always a major deterrent to the production of quality programmes, significant gains can be made in some situations at a relatively low cost.
4. The unit cost of high quality, high cost programmes can be reduced by imagination and co-operative effort on the part of potential users.
5. Man's ingenuity in the manipulation of human and mechanical resources can and will produce levels of effectiveness in the teaching and learning process that were never possible heretofore.

References:

(1) Kent L. Gustafson, "Toward a Definition of Instructional Development", a paper presented at the conference of A. E. C. T., March, 1971.

(2) C. R. Carpenter, "A Constructive Critique of Educational Technology", Audio-Visual Instruction, Vol. 1, Spring 1968, P. 19

(3) Alexander Schure, "Educational Escalation Through Systems Analysis", Audio-Visual Instruction, May, 1965, P. 372.

(4) Learning Systems Company, Division of Richard D. Irwin, Inc., Homewood, Ill.

(5) Leslie J. Briggs, Handbook of Procedures for the Design of Instruction. American Institutes for Research, September, 1970, Pages 17 & 18.

(6) Robert L. Docter: Testimony before the Joint Committee on Educational Goals and Evaluation, P. 2.

(7) Ibid, P. 5.

(8) Helen D. Dell, the PLAN Master List of Objectives, Introduction, Page x, American Institute for Research, Palo Alto, Calif.

(9) Ibid.

(10) The System for the Individualization and Optimization of Learning Through Computer Management of the Educational Process, New York Institute of Technology, Project # 8-0157, Office of Education, Bureau of Research.

(11) Richard E. Spencer, The Role of Measurement and Evaluation in Instructional Technology, a paper presented to the Commission on Instructional Technology and published in the book To Improve Learning, Vol. II, R. R. Bowker Company, New York and London, 1971, Pages 838 and 839.

(12) W. James Popham, Instructional Objectives Exchange Catalogue, P. O. Box 24095, Los Angeles, Calif.

(13) John B. Carroll, Measurement and Evaluation in Educational Technology, a paper presented to the Commission on Instructional Technology, and published in the book To Improve Learning, Vol. 11, Page 821.

(14) Ibid, P. 813

(15) Richard E. Spencer, The Role of Measurement and Evaluation in Instructional Technology, a paper presented to the Commission on Instructional Technology and published in the book To Improve Learning, Vol. II, R. R. Bowker Company, New York and London, 1971.

(16) Leslie J. Briggs, Handbook of Procedures for the Design of Instruction, American Institute s for Research, Sept. 1970, Pages 63, 64 and 65.

(17) Ibid, P. 66.

(18) M. Scriven, The Methodology of Evaluation. In Tyler, et al. Perspectives of Curriculum Evaluation, Rand McNally, 1967, Pages 39-83.

(19) Leslie J. Briggs, Handbook of Procedures for the Design of Instruction, American Institutes for Research, Sept. 1970, Pages 65 and 66.

(20) John B. Carroll, Measurement and Evaluation in Educational Technology, published in the book To Improve Learning, Vol. II, R. R. Bowker Company, New York and London, 1971, P. 820.

(21) The System for the Individualization and Optimization of Learning Through Computer Management of the Educational Process, New York Institute of Technology, Project # 8-0157, Office of Education, Bureau of Research.

(22) Ibid, Report on Phase 11, edited by J. Ward Harrigan.

(23) C. R. Carpenter, a Constructive Critique of Educational Technology, AV Communications Review, Spring, 1968, Page 21.

(24) William H. Allen, Instructions Media Research: Past, Present and Future, AV Communications Review, Spring, 1971, Pages 11 and 12.

(25) Donald T. Tosti and John R. Ball; A Behavioural Approach to Instructional Design and Media Selection, AV Communications Review, 17/1, 1969, P. 8

(26) L. J. Briggs, P. L. Campeau, R. M. Gagne & M. A. May, Instructional Media: A Procedure for the Design of Multi-Media Instruction, A Critical Review of Research and Suggestions for Future Research. American Institute for Research, 1967, P. 29.

(27) Reference unknown.

(28) To Improve Learning, Vol. I, Edited by S. G. Tickton, R. R. Bowker Company, New York and London, 1971, P. 225.

(29) William H. Allen, Media Stimulus and Types of Learning, AV Communications Review, Jan. 1967, P. 27.

(30) Robert M. Gagne, Learning Theory, Educational Media, and Individualized Instruction; a paper prepared for faculty seminars sponsored by Buckness University and the U. S. Office of Education, Pages 18 and 19.

(31) Donald T. Tosti and John R. Ball, "A Behavioural Approach to Instructional Design and Media Selection", AV Communications Review, Vol. 17, No. 1, 1969, P. 9.

(32) M. David Merrill, "Toward a Theory-Based Approach to Instructional Development", Working Paper No. 16, Dept. of Instructional Research and Development, Division of Instructional Services, Brigham Young University, 1971.

(33) Donald T. Tosti and John R. Hall, Op Cit, P. 16.

(34) Dr. Thad B. Green and Dr. Morton Cottar, A New Dimension in Management Training: A Video-Audio-Participative (VAP) System, Training and Development Journal, Oct. 1970, Pages 22-27.

ERIC Clearinghouse
APR 3 1972
on Adult Education